

REMARKS

The present Amendment and Response is intended to be fully responsive to all points of objection and/or rejection raised in the Office Action dated 30 October 2007. The present Amendment and Response is believed to place the application in condition for allowance. Favorable reconsideration and allowance of the application are respectfully requested.

Applicants assert that the present invention is new, non-obvious and useful. Prompt reconsideration and allowance of the claims are respectfully requested.

Status of the Claims

Claims 1, 4-5, 13 and 15 are pending in the application. Claims 1 and 4-5 have been amended for clarity. Applicants assert that the amendments are fully supported by the specification of record and add no new matter.

Examiner Interview

Applicants would like to thank the Examiner for granting a telephonic interview with Applicant's representative, Lisa Jaklitsch (Registration No. 45, 168) on 20 February 2008 to discuss the present application. Applicant's representative presented arguments with regard to 35 U.S.C. §103 rejections of independent claims 1 and 13. During the interview, the Examiner advised that use of the term "substantially" is overly broad. Applicants have amended claims 1 and 13, accordingly, in an effort to expedite prosecution. Applicants respectfully reserve the right to pursue use of the term "substantially" in continuation applications, as the federal circuit has held that the term "substantially" is definite. (MPEP §2173.05(b)). Applicants kindly request that the Examiner reconsider the rejections.

Claim Objections

The Office Action objected to independent claims 1 and 13. In particular, the Office Action advised that the term "impurities" should be changed to "impurity" in claims 1

and 13 and the phrase “said first content of impurity of said impute copper seed layer” should be changed to “said first content of impurity of said impure copper seed layer” in claim 1.

In response, Applicants have amended independent claim 1 and 13 in accordance with the Office Action’s advisement.

Applicants respectfully assert that the amendments to claims 1 and 13 are fully supported by the specification and add no new matter. Applicants respectfully request withdrawal of the claim objections.

Remarks to Claim Rejections

Claim Rejections - 35 USC §112

The Office Action rejected independent claim 13 under 35 U.S.C. §112, 2nd paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In particular, the Office Action alleges that the claim requirement “the impure copper fill” lacks antecedent basis. In addition, the Office Action alleges that the wording in paragraph 5 of claim 13 is “totally contradicting.”

In response, Applicants have amended claim 13 both to address the antecedent basis rejection and clarify the wording in claim 13.

Applicants respectfully assert that the amendments to claim 13 are fully supported by the specification and add no new matter. Applicants respectfully request withdrawal of the 35 USC §112, 2nd paragraph rejection.

Claim Rejections - 35 USC §103

The Office Action rejected claims 1 and 13 under 35 U.S.C. §103 as being unpatentable over Andricacos et al. (U.S. Patent No. 6,709,562, hereinafter Andricacos) in view of Noriyoshi et al. (JP 11-297696, hereinafter Noriyoshi). In short summary, Andricacos does not disclose, teach or suggest an impure copper seed layer derived from

an impure copper source. The Office Action relies on Noriyoshi for such teaching.

Applicants would like to point out a seemingly contradictory statement in the Office Action. The Office Action states that Andricacos does not explicitly teach the impure copper seed layer claim requirement, the Office Action states

Fig. 6 of Andricacos teaches an impure copper (reference numeral 6) derived from an impure copper source (6) with a content of impurities (see col. 2, lines 60-67) that fills an opening in said underlying insulating layer (1) that is deposited on said impure copper seed layer (5).

Andricacos, contrary to the assertion in the Office Action, does not indicate that “Cu 6” is impure. The “impure copper seed layer” is required by each and every claim in the application. The claims further require “the material composition of said impure copper seed layer is the same as material composition of said impure copper fill except some impurities in the impure copper fill are absent from the impure copper seed layer.” Such claim requirement is also required by each and every claim in the application.

While in a first instance the Office Action admits that Andricacos does not disclose an impure copper seed layer, the Office Action in the very next instance states that Andricacos does disclose an impure copper seed layer. Applicants repeatedly and respectfully assert that Andricacos does not disclose an impure copper seed layer. The Office Action seems to recognize this deficiency in Andricacos, and discusses Noriyoshi for a teaching of an impure copper seed layer. Reliance on Noriyoshi for a teaching of such claim requirement, however, does not compensate for Andricacos’ deficiencies.

All claims require not just “an impure copper seed layer,” but also “an impure copper fill,” and further that “the impure copper seed layer and the impure copper fill have the same material composition except some impurities in the impure copper fill are absent from the impure copper seed layer.” Such claim requirements are not found in either Andricacos or Noriyoshi. Moreover, such claim requirements are not trivial. The invention has remarkably stumbled upon an unexpected result of the use of an impure copper seed layer. More specifically, the invention has discovered that use of an impure copper seed layer with a particular balance of impurities prevents dendritic formation.

Prior art techniques for the formation of a copper interconnect required the deposition of a pure copper seed layer. The prior art required use of a pure copper seed layer because it was known that pure copper seed layers improves the facilitation of copper nucleation. (Specification, ¶5). Therefore, Applicants use of “an impure copper seed layer” was and continues to be contrary to conventional wisdom. Use of “an impure copper seed layer”, according to conventional wisdom, retards copper nucleation. In addition, a dangerous and potential disastrous consequence of “an impure copper seed layer” is that the “impure copper seed layer” could become resistive. (Specification, ¶22). If too many impurities are contained in the “impure copper seed layer,” the copper becomes resistive. (Specification, ¶22). A delicate balance of impurities is required to prevent the copper from becoming resistive. Such balance is consequentially claimed. All claims require that “said impurity content comprises not more than 1.20% by weight and not less than or equal to 0.001% by weight of said impure copper seed layer.” The balance claim requirement is further not disclosed, taught or suggested by either Andricacos or Noriyoshi.

For the foregoing reasons, the invention is patentable over Andricacos in view of Noriyoshi. That said, for this additional reason the invention is patentable over Andricacos in view of Noriyoshi. Even if one were to combine Andricacos and Noriyoshi, such combination would not disclose the claim requirement of “the material composition of said impure copper seed is the same as material composition of said impure copper fill except some impurities in the impure copper fill are absent from the impure copper seed layer.” The Office Action relies upon the statement in Noriyoshi that “Sn 0.5% of the wt as the impurity.” Andricacos does not disclose any percentage of Sn contained in the copper fill. Therefore, the combination of Andricacos and Noriyoshi does not disclose, teach, or suggest the claimed material composition claim requirement, and the combination of Andricacos and Noriyoshi could not disclose, teach, or suggest the further claim requirement regarding the percentage of impurity content. For this additional reason, the claims are patentable over the combination of Andricacos and Noriyoshi. Therefore, Applicants respectfully request withdrawal of the 35 USC §103 rejection.

Conclusion

In view of the foregoing remarks, Applicants respectfully submit that all pending claims are in condition for allowance. Favorable reconsideration and allowance of the claims are respectfully requested.

No fees are believed to be due in connection with this paper. However, if there is any such fee due, please charge any such fee to the deposit account No. 09-0458.

Respectfully submitted,

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